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Use of scales as biomarkers to determine changes in habitat ecology and biology of some fresh water teleosts

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Abstract

Scales on fish body perform some important function in fish life as exoskeleton mainly to protect the body from external injury and pathogens. Teleosts distributed in fresh water, marine water and brackish water habitat mainly cycloid and ctenoid scales are found. Body scales in fishes are the real mirrors of characters of habitat, fish biology and fish health. It is most simple and easiest, non-expensive way to determine the changes in habitat and fish body because that get reflected fully or to some extent on fish body scales.

Present study deals with the investigations on changes in basic scale structures of some important fish species like *Catla catla*, *Cirrihina mrigala, Puntius ticto, Etroplus species, Channa species, Rohtee species, Chela species* and other common teleosts to determine in habitat ecology and biology of some fresh water species.

Introduction

In 1998, the National Institutes of Health Biomarkers Definitions Working Group defined a biomarker as “a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention.” Fish increasingly attract

public, scientific and political interest around the world. Recreational and commercial fisheries are prominent in our societies; fish issues take a highly relevant position in discussions related to conservation biology (Baker et al, 2013) and environmental protection efforts (*e.g*. effects of climate change, novel predators, novel animal-environment relationships on stress and as a consequence on fitness) (Boonstra et al 2013 and Connor et al, 2014). Anthropogenic activities (*e.g*. energy production, shipping traffic, industrial pollution) compromise wild stocks (Richardson et al, 2013). Therefore, various international monitoring schemes aim to scientifically clarify their impact on the health status of oceanic niches. A similar situation exists for freshwater stocks as they are under threat by soil erosion, fertilizers, etc. as agriculture expands. Scales on fish body perform some important function in fish life as exoskeleton parts mainly to protect the body from external injury and pathogens. In present days teleosts distributed in fresh water, marine water and brackish water habitat mainly cycloid and ctenoid scales are found. There is variation observed in the morphology of these types of scale (Ansari et. al., 2016). These variation are in the number of circuli and annuli, types of lepidonts, the arrangement of circulii, annuli and location of focus on the scale. Therefore the concept of types of scales has changed with addition of new morphological structures on scale surface. Body scales in fishes are the real mirrors of the characters of habitat, fish biology and fish health. It is most simple and easiest, non-expensive way to determine the changes in habitat and fish body because that get reflected fully or to some extent on fish body scales. Scales are regenerating and replaced body parts when they lost due to several ecological and biological reasons. Scales are indicators of growth of fish body, in salmons there are spawning marks get developed during spawning. Effect of pathogens to

produce a disease and irregularity in growth due to parasitism also get reflected in varied surface morphology of scales. The waste, discarded scales *Tilapia* species are now days used in adsorption of heavy metals and pollutants like Fe. Hg, Zn, Al, CO, Ni and Cd (Singh et. al., 2013; M. Othman et. el., 2016) from the waste water. With this idea the commercialization of similar materials that present in the scales may be used on large scale in the treatment of effluents from sewage. Taking in to consideration the importance of scales as a waste material generated from fish market the Japanese scientist have tried to develop an artificial bones.

Present study deals with the investigations on changes in basic surface structures in some important fish species like *Catla catla*, *Cirrihina mrigala*, *Puntius ticto*, *Etroplus species*, *Channa species*, *Rohtee species*, *Chela species* and other common teleosts which in fish markets of Nanded city, Maharashtra State, India.

Godavari is one of the greatest river in India containing variety of aquatic life specially different species of teleosts. Therefore it is good opportunity to study teleosts at Nanded.

Objectives of the study

1) To determine the detail morphology of scale of selected fishes using Phase contrast microscopy photography and SEM.
2) To specify the body part specific morphological differences in scales and further specification with region, habitat, niche, sexual dimorphism, age, spawning state of fish.
3) To determine the changes in circulii, annuli, lepidonts, pores for lateral line and chromatophores due to pollution impact. It will be supported through In-Vitro studies.

4) To confirm and specify the role of fish body scale as biomarker with or without additional supporting analytical studies.

Review of Literature

The review of literature given as under indicates that the study which is planned through the selected method and fish is not worked out. The data on the selected topic is very fragmented and have huge scope to workout. It is simplest method and little expensive too in the modern era of expensive analytical instrumental methods. Laith A. Jawad (2005), was studied scale surface morphology and squamation patterns provide new and useful information for *tripterygiid* systematic. It was also investigate the squamation on the head belly, caudal peduncle, and fins and various types of body scales are observed like elliptic, oblong, pentagonal, rectangular, rounded square, triangulae, and cycloid. This study must be considered preliminary because of a total of about 132 *tripterygiid* species; only 37% have been examined so far. H.R.Esmaeili, et.al (2012), In this paper the researcher studied on native species *Garra rossica* of south-eastern Iran observed about anterior and posterior region position of focus, and focus covered by reticulate and honeycomb from structures with few mucous pores and shaped of circuli in anterior and lateral field and narrow grooves called radii. On the dorsal side, the anterior circuli bear numerous pointed lepidonts. Several types of pigmented granules have different shapes and sizes and Canal observed in it. Namanpreet Kaur and Anish Dua, (2004), revealed that features on the scales that contribute towards identification among the species belonging to the genus *Labeo*. Four species of *Labeo*, viz, *L. calbasu, L. rohita, L. gonius and L. bata* have been considered for the analysis of scales (normal, regenerated and lateral line scale) with the help of SEM. D.R.Khanna, et.al. (2007), studied fish scales as a bio-indicators so that they

selected Ganga river. The physico-chemical parameter of water to effect on living organisms specially on fishes. Hence investigator used scales of some fishes like *Puntius Sarana Sarana, Labeo rohita* that commonly found in Ganga with the help of SEM they observed the scales damages, to the lepidonts, broken edges, completely ruptured. Investigation showed the overall result that high total solids, turbidity, suspended particulates, presence of heavy metal particulates, high inorganic or organic load for long period effect on lepidonts, of scales the complete row of lepidonts were found ruptured other body parts like gills, structure of scales and length weight of fishes also damaged. Loosening of scales from the fish body this is mainly due to pollutions load. It is a reliable method for assessment water quality on the basis of observing the effecting living organisms especially fishes which has a high quality in water ecosystems. K.Prabu, et.al. (2012), Investigators revealed that the potential of fish scale (*Catla Catla)* as a biosorbent for absorbing the heavy metals from the synthetic waste water aqueous solution. The biosorption activity of the fish scales was studied under various parameters such as effect of dosage effect of time and the effect of pH. So the study revealed that fish scale act as a biosorbent and it also can be used for waste water, treatment at industrial level. Onkarsingh Brraich and Sulochana Jangu (2008), investigator revealed that the effect of heavy metal pollutants on scales of fresh water fish *Cyprinus carpio* with the help of SEM and energy dispersive X-ray Microanalysis (EDX). This study revealed that the elemental composition of the scale is directly related to the hydrochemistry of the aquatic enrivonment in which the fish inhabits. Hence the scale of *Cyprinus carpio* can be considered, as a reliable pollution indicator with authentically. N. Othman, et al. (2016), used *Mozambique tilapia (M.tilapia*) fish scales as a biosorption of heavy metals. Heavy metals like Zn and Fe ion. After

biosorption processes. SEM – EDX analysis revealed that presences of shiny bulky particles that indicate the appearance of Zn, and Fe ions after biosorption. This researcher showed that *M. tilapia* fish scales is useful. Neeraj Gupta and Anish Dua, (2014), investigated the use of *Channa Punctatus* fish scales from different regions from the body of fish for elemental composition to see the impact of mercury on them. So this present study revealed that scale of *Channa Punctatus* was a good tool to assess the toxiocological impact on the fish both qualitatively and quantitatively and it is useful for as a successful pollution indicator.

Materials and Methods

Study area:

The Study is not area specific rather than it is fish specific Fish samples will be collected from Fresh water fishes from Godavari river and its tributaries, All major and Minor Reservoirs.

Probable outcome of the research

1. The type of change in scale structure especially lepidonts on the circulli and annuli related to pollution specific impact will be determined.
2. Scales located at lateral lines are having opening through the focus, that communicates with the lateral canal system, the deposition of salts, heavy metal ions and the blockage of scale openings may greatly harm the sensory system in fishes, the level of damage to sensory systems get reflected on scales, that can be determined through observation of scales.
3. The ecological status of fish habitat in terms of silting, deposition of certain pollutants and the productivity can be determined by observing the scale structural changes.

4. The degree of changes in scales due to exposure to various concentration of commonly used insecticides and weedicides can be determined, instead of exposure of fish to such pollutants. Hence the role of scales as biomarkers will be identified.
5. Subjecting the scales to decomposition process using soil as medium and role of bottom debris in scale decomposition will be determined; that will help to determine the strength of scales to decomposition process.

Importance of study

1) International Status:

On the fish scales abundant research work done in the various countries viz. India, Iran, Egypt and Pakistan etc. The work like surface morphology of scale of different species of fishes and artificial bone development study was carried out in Japan. Scales are used as biomarkers of pollutant and water quality.

2) National Status:

In India the work done on the scale is morphological identification of scales different fishes and scale used in the biosorption in the polluted ecosystem.

3) Significance of the Study:

The study is significant because in which scales are used to determination of change in habitat ecology in specific group of fish and determine the metal composition in the scale.

Annual plan of work:

As given in below the thesis is divided into various chapters, accordingly the investigation on the problem will be carried out.

Chapter-1

Morphological study of scales in selected fishes

Chapter-2.

Changes in morphology of scales when subject to exposure of scales to different conditions similar to habitat conditions

Chaptet-3.

Changes in selected fish scale ultra-structures when subjected to decomposition.

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